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Short communication

Analysis of apolipoprotein genes and their involvement in disease response of channel catfish after bacterial infection

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ABSTRACT

Apolipoproteins are protein component of plasma lipoproteins. They exert crucial roles in lipoprotein metabolism and serve as enzyme cofactors, receptor ligands, and lipid transfer carriers in mammals. In teleosts, apolipoproteins are also involved in diverse processes including embryonic and ontogenic development, liver and digestive system organogenesis, and innate immunity. In this study, we identified a set of 19 apolipoprotein genes in channel catfish (*Ictalurus punctatus*). Phylogenetic analysis and syntenic analysis were conducted to determine their identities and evolutionary relationships. The expression signatures of apolipoproteins in channel catfish were determined in healthy tissues and after infections with two major bacterial pathogens, *Edwardsiella ictaluri* and *Flavobacterium columnare*. In healthy channel catfish, most apolipoprotein genes exhibited tissue-specific expression patterns in channel catfish. After ESC and columnaris infections, 5 and 7 apolipoprotein genes were differentially expressed respectively, which presented a pathogen-specific and time-dependent pattern of regulation. After ESC infection, three exchangeable apolipoproteins (apoA-IB, apoC-I, and apoE-B) were suppressed in catfish intestine, while two nonexchangeable apolipoproteins (apoB-A and apoB-B) were slightly up-regulated. After columnaris infection, apoB-B, apoD-B, and apoE-A were significantly down-regulated in catfish gill, while apoF, apoL-IV, apoO-like, and apo-14 kDa showed significantly up-regulation. Taken together, these results suggested that apolipoprotein genes may play significant roles in innate immune responses to bacterial pathogens in channel catfish.

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1. Introduction

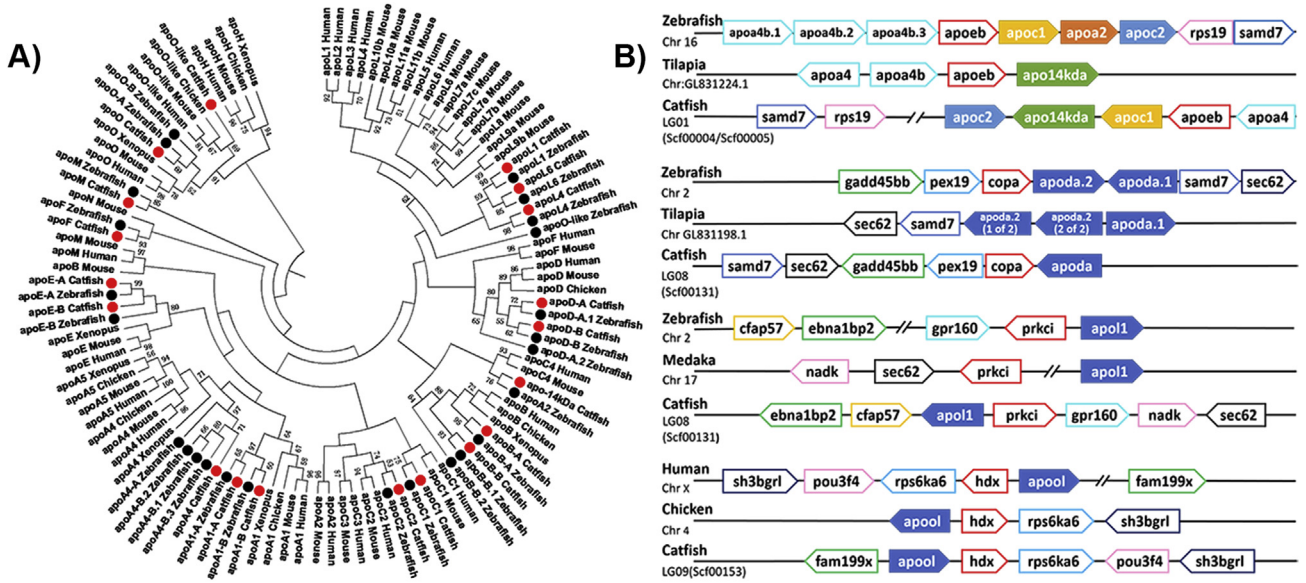
Apolipoproteins, the structural components of various plasma lipoproteins, bind and transport lipids to various tissues through lymphatic and circulatory systems (Havel, 1975; Kondo et al., 2005). Most of apolipoproteins are mainly synthesized in liver, intestine, and adipose tissues, which interact with lipoproteins and form distinct lipoprotein complexes depending on apolipoprotein species (Mahley et al., 1984). Apolipoproteins are mainly grouped into two major types in vertebrates, exchangeable and non-exchangeable apolipoproteins. Exchangeable apolipoproteins (apoA, apoC and apoE classes) are low-molecular-weight proteins featured by repeated amphipathic alpha helix regions for reversible lipid and lipoprotein binding (Babin et al., 1999; Wang et al., 1997).

Non-exchangeable apolipoproteins, mainly comprised of apoB class, contain amphipathic beta-strand domains as their lipid-associating motif and associate with lipid droplets irreversibly (Segrest et al., 1998). In addition to these two typical types of apolipoproteins, there are also atypical apolipoproteins, including apoD, apoF, apoH, apoL, apoM, apoN, and apoO classes. They have no similarities to exchangeable or non-exchangeable apolipoproteins, but are also associated with plasma lipoproteins and involved in lipid metabolism (Page et al., 2001; Xu and Dahlbäck, 1999).

Apolipoproteins exert crucial roles in regulating the metabolism of lipoproteins and serve as enzyme cofactors, receptor ligands, and lipid transfer carriers in mammals (Mahley et al., 1984). Notably, apolipoproteins are also involved in various metabolic states and immune responses (Hardardóttir et al., 1997; Van den Elzen et al., 2005). In mammals, many apolipoprotein species have been reported to have roles in modulating the inflammatory response to a major pathogenic factor lipopolysaccharide (LPS), either by directly

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C)

Name	Chc	Zbf	Mdk	Fugu	Til	Frog	Lzd	Chk	Cow	Mou	Hum
apoA1	2	2	1	1	1	1	0	1	1	1	1
apoA2	0	1	1	1	1	0	0	0	1	1	1
apoA4	1	4	3	4	3	1	1	1	1	1	1
apoA5	0	0	0	0	0	1	0	1	1	1	1
apoB	2	3	5	2	4	1	1	1	1	1	1
apoC1	1	1	0	0	0	0	0	0	0	1	1
apoC2	1	1	0	1	0	0	0	0	1	1	1
apoC3	0	0	0	0	0	0	0	0	1	1	1
apoC4	0	0	0	0	0	0	0	0	1	1	1
apoD	2	3	6	4	7	0	0	1	1	1	1
apoE	2	2	2	2	2	1	0	0	1	1	1
apoF	1	1	1	0	1	0	1	0	1	1	1
apoH	0	0	2	2	1	1	0	1	1	1	1
apoL1	1	1	1	1	1	0	0	0	0	0	1
apoL2	0	0	0	0	0	0	0	0	0	0	1
apoL3	0	0	0	0	0	0	0	0	1	0	1
apoL4	1	1	1	0	0	0	0	0	0	0	1
apoL5	0	0	0	0	0	0	0	0	0	1	1
apoL6	1	1	0	0	0	0	0	0	1	1	1
apoL7	0	0	0	0	0	0	0	0	0	4	0
apoL8	0	0	0	0	0	0	0	0	0	1	0
apoL9	0	0	0	0	0	0	0	0	0	2	0
apoL10	0	0	0	0	0	0	0	0	0	2	0
apoL11	0	0	0	0	0	0	0	0	0	2	0
apoM	1	1	1	0	0	1	1	0	1	1	1
apoN	0	0	0	0	0	0	0	0	1	1	0
apoO	1	2	2	0	2	1	0	1	1	1	1
apoO-like	1	1	1	1	1	1	1	1	1	1	1
apo-14kDa	1	0	0	1	1	0	0	0	0	0	0
Total	19	25	27	20	25	9	5	8	18	30	22

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